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CAPACITIVE IRIS BANDPASS FILTERS WITH SPURIOUS HARMONIC MODES SUPPRESSION

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ABSTRACT

A new design of capacitively coupled bandpass filter, that provides suppression of spurious passbands for the dominant and the second waveguide modes without any extension of the filter dimensions, keeping the same return loss within the passband, is presented. Spurious passbands suppression is provided by cutting in iris strips additional pair of slots. Cutting the additional slots leads to the appearance of attenuation poles, which are placed in the spurious passbands. The k -inverter of corresponding two-side double-slot iris changes slightly and may be easily fine-tuned. Numerical examples are presented for the three-section 5% filter in wr90 waveguide.

INTRODUCTION

Directly coupled bandpass filters are widely used structures in practical design of space and ground-based microwave systems. However it was found in practice [1] that if a bandpass filter is used in a complex microwave system, the spurious second harmonic mode appears in supposed attenuation band. This may cause a serious interference problem, leading to a degradation of the filter frequency response. As it was proposed in [1] one should use asymmetric filters with improved attenuation band or ridged filters, in which the second harmonic mode cannot propagate through the filter.

In this report we propose a new design of capacitively coupled bandpass filters that provides effective suppression of the spurious harmonic passbands for both the dominant and the second waveguide modes. It is achieved due to the cutting additional horizontal slots in the strips of coupling irises (see Fig. 1). In contrast to ridged filters the second waveguide mode can propagate through the filter under consideration. Although we failed to suppress it's the main passband, we succeeded in suppression of its spurious passband, the dominant mode spurious passband and in increasing the attenuation level of the dominant mode in the frequency range corresponding to the main passband of the second waveguide mode. Moreover, we succeeded in significant reduction of electric field strength magnitude within the coupling irises.

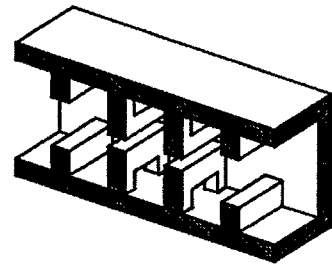


Fig. 1. Draft of the bandpass filter based on the two-side double-slot capacitive irises

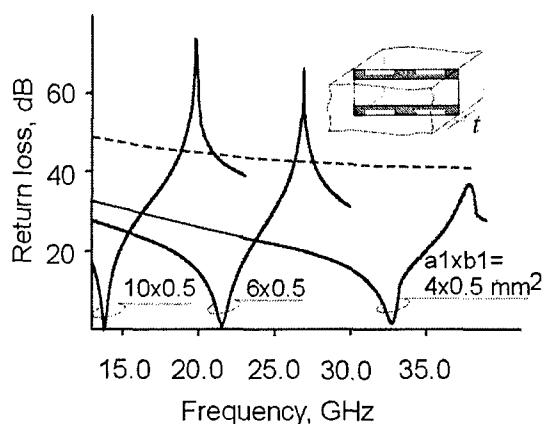


Fig. 2. The modification of return loss response for the double-slot two-side strip in WR90 with decreasing the slot width, $t=0.5$ mm.

sections that form the parasitic passband. Moreover, as it is demonstrated in [2] the multislot configurations are able to reject simultaneously not only the dominant mode but also the higher ones in the two- or three-mode frequency bands. Four configurations of the slotted strip that is able to reject the dominant mode are shown in Fig. 3. Two-side double-slot strip has the richest properties as to a frequency harmonic mode suppressor of the resonance type. There is a quadruplet of eigen-oscillations symmetrical and asymmetrical in the OX or OY directions with very close real and imaginary parts of their complex

eigen-frequencies. This fact makes possible to reject three modes simultaneously: TE_{10} , TE_{20} , and TM_{11} . This configuration has been chosen as a modified coupling section for the filter under consideration.

Numerical results are demonstrated by two examples of a 5% third order filter in WR90 (Fig. 4). Left-hand side and right-hand side responses from the Fig. 4 correspond to the classic BPF and the BPF with two identically modified (two-side and double-slot) interior coupling irises, respectively. Black solid and dashed curves correspond to the insertion loss for the dominant mode and the second mode, respectively. Modified interior sections of the latter filter provide attenuation poles in the spurious passband for the dominant mode. As a consequence, the spurious passband is shifted with

RESULTS

The salient feature of the slotted strips to reject waveguide modes is on the base of achieved results. It was shown in [2] that cutting additional slot(s) in the iris strips (symmetrical central-placed or two-side) provides a resonance of total rejection in the response. The location of this resonance is mainly determined by the slot width a_1 (see Fig. 2), whereas its quality depends primarily on the thickness of the metal "bridge(s)", separating the main iris slot and the new ones, and on the resonant slot height b_1 . Note a rejection can be provided in the whole operating range of rectangular waveguide up to the frequency band of the second longitudinal resonances of the filter

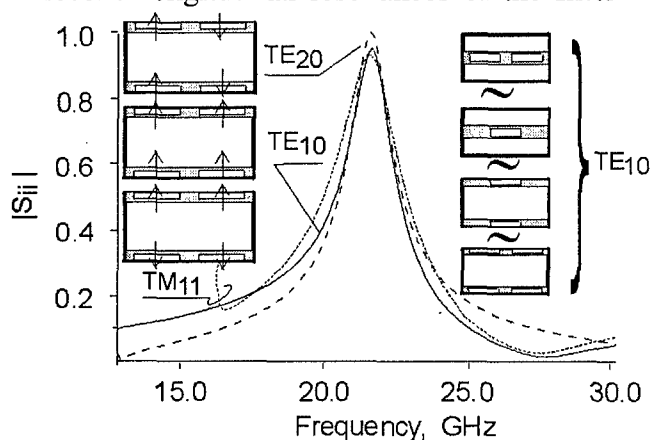


Fig. 3. Reflection coefficients of the dominant and higher modes from double-slot two-side-strips with $a_1 \times b_1 = 6.0 \times 0.5$ mm² in WR90, $t=0.5$ mm

simultaneous improvement of stopband attenuation in general. It is clear that the filter configuration shows an excellent opportunity to suppress the main part of the spurious passband for the second waveguide mode. Notice that the frequency responses are almost identical within the passband. Besides, the electric field strength magnitude in modified iris sections is approximately equal to the one for the corresponding inductively coupled filters.

CONCLUSIONS

A new design of the bandpass filters provides the improvement of frequency response regarding to the bandstop attenuation for both the dominant mode and the second modes as well. By choosing the appropriate set of slots it is easy to implement several attenuation poles, suppress the parasitic passbands and to achieve the better passband separation. Moreover cutting the slots in the iris strips provides a considerably lower magnitude of the electric field strength within basic of the slot iris. For all the filters the new properties are achieved without increasing both the transversal and longitudinal filter dimensions.

REFERENCES

- [1]. Wu K.-L., McDonald G., "Coping with hidden Spurious Harmonic Modes in the Design of Low Pass Corrugated Waveguide Filters," *Microwave journal*, V.44, №11, 2001, pp. 180-186.
- [2]. Kirilenko A.A., Mospan L.P., "Harmonic Rejection Filters For The Dominant and Higher Waveguide Modes Based On The Slotted Strips", 2002 IEEE MTT Symposium, pp.373-376.

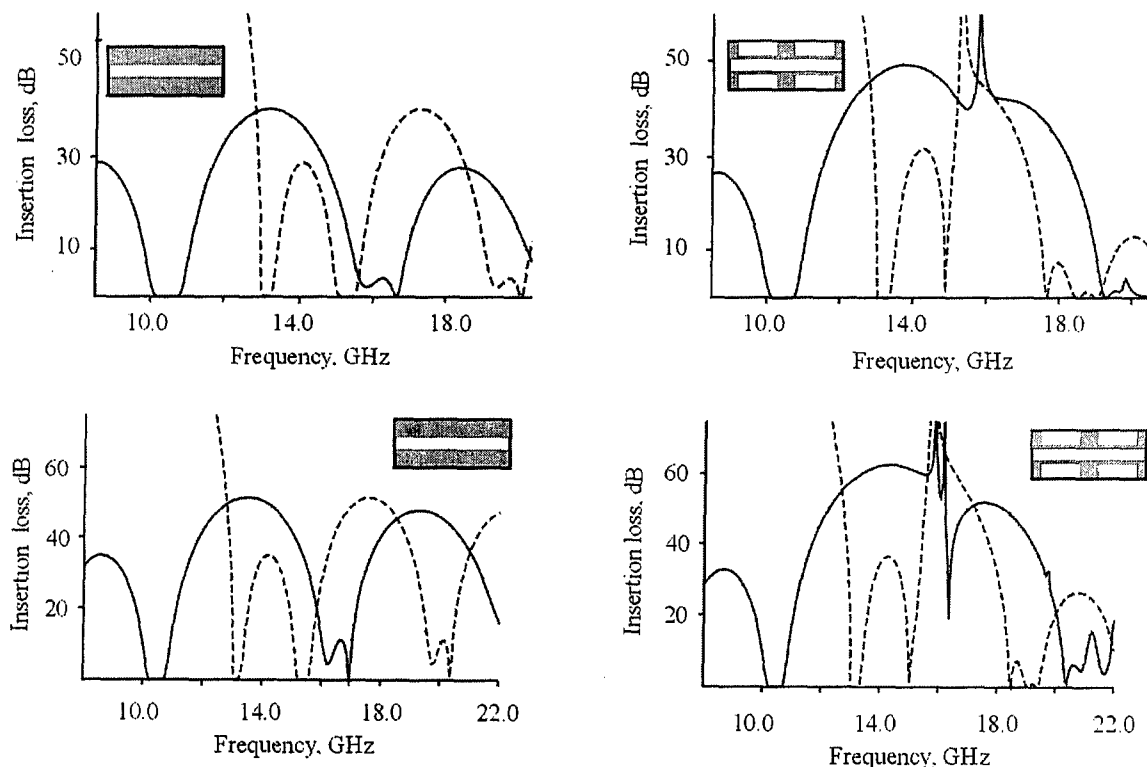


Fig. 4. The frequency responses of 5% classic bandpass filters and the filters with two identically modified internal irises that provide suppression of the spurious passbands for both the dominant and the second waveguide modes